CLAIMS:

1. A sensor for use in a device for non-contact detection of an external field by positioning the sensor at a spot where the external field is to be detected, the sensor comprising a delay line, which is to be exposed contactlessly to action of the external field and comprises:

a transducer arrangement that is provided on a substrate made of a material capable of transporting therethrough a wave sensitive to said external field, and defines a wave channel for the wave propagation through the substrate, the transducer arrangement being capable of being actuated by an interrogation signal to generate said wave propagating through the wave channel and capable of converting the wave into an output response signal, said external field affecting a change in a velocity of the wave propagation, said output response signal being thereby informative of said external field.

2. The device according to Claim 1, wherein said external field to be detected is a magnetic field, said substrate is made of ferrite, and said wave is a magnetic wave.

3. The device according to Claim 1, wherein said external field to be detected is an electric field, said substrate being made of a piezoelectric material, and said wave being a surface acoustic wave (SAW).

4. The device according to Claim 1, wherein said external field to be detected is an electric field, said substrate being made of an electrostriction material, and said wave being a surface acoustic wave (SAW).

5. The sensor according to Claim 1, wherein said transducer arrangement comprises one pair of transducers defining said wave channel therebetween.

6. The sensor according to Claim 1, wherein said transducer arrangement comprises a phase-coded transducer capable of being actuated by a phase coded interrogation signal, said output response signal being maximal at a

predetermined external field, at which the interrogation signal matches with the code of the transducer, the value of said output response signal being indicative of the external field affecting the velocity of wave propagation.

7. The sensor according to Claim 1, and also comprising an additional delay line formed by an additional transducer arrangement defining an additional wave channel, wherein said additional wave channel is screened from said external field and length of the wave channels being different, said output response signal being a vector sum of output signals of the two wave channels.

8. The sensor device according to Claim 1, and also comprising a field transformer operable to increase intensity of a field affecting the velocity of the wave propagation within the channel, as compared to the external field intensity, according to a known proportion.

9. The sensor according to Claim 8, wherein said field transformer is composed of two capacitors of different values of a capacity and a distance between the capacitor plates, such that the capacitor of a smaller capacity has a smaller distance between its plates, as compared to the other capacitor, the two capacitors being connected in parallel and being mounted at said spot where the external field is to be detected, the capacitor of the smaller capacity enclosing said delay line in a dielectric space between its place, the inner field of said capacitor of the smaller capacity affecting the velocity of the wave propagation through the channel.

10. The sensor according to Claim 8, wherein said field transformer comprises a metal element having a part thereof formed with a sharp edge, the field transformer serving as a concentrator of the external field, which is to be detected, within the delay line, when said metal plate is located in said spot so as to extend predominantly along the external field, and said sharp edge is located in the close vicinity of the delay line.

11. A sensor for use in a device for non-contact detection of an external field in the vicinity of an electric wire, the sensor comprising:

- a substrate carrying a delay line to define a wave channel for the wave propagation through the substrate, and
- a field transformer operable to increase intensity of a field within a delay line, as compared to the intensity of the external field in the vicinity of the wire outside the delay line, in a known proportion, the increased field affecting a velocity of the wave propagating within the delay line;
- the delay line comprising a transducer arrangement capable of being actuated by an interrogation signal to generate said wave propagating through the wave channel and capable of converting the wave into an output response signal, said wave channel being exposed contactlessly to action of the field created by said field transformer and proportional to external field to be measured, which effects a change in a velocity of the wave propagation, said output response signal produced by the passive unit being thereby informative of said external field.

12. A device for non-contact detection of an external field, comprising said sensor according to Claim 1, and an active unit operable to emit said interrogation signal to be received at said sensor, receive said output response signal and process said output response signal for determining and indicating the external field.

13. A device for non-contact detection of an external field, comprising:

- active and passive units, wherein the passive unit is to be positioned at a spot where the external field is to be detected, and the active unit is operable to emit an interrogation signal to be received at the passive unit, receive an output response signal coming from the passive unit, and process said output response signal for determining and indicating the external field, the passive unit comprising:

- a substrate made of a material capable of transporting therethrough a wave sensitive to said external field, and
- a delay line provided on said substrate to define a wave channel for the wave propagation through the substrate, the delay line comprising a transducer arrangement capable of being actuated by said interrogation signal to generate said wave propagating through the wave channel and capable of converting the wave into said output response signal, said wave channel being exposed contactlessly to action of the external field, which effects a change in a velocity of the wave propagation, said output response signal produced by the passive unit being thereby informative of said external field.

14. The device according to Claim 13, wherein said external field to be detected is a magnetic field, said substrate is made of ferrite, and said wave is a magnetic wave.

15. The device according to Claim 13, wherein said external field to be detected is an electric field, said substrate is a piezoelectric substrate and said wave is a surface acoustic wave (SAW).

16. The device according to Claim 13, wherein said transducer arrangement comprises a pair of transducers placed on a surface of said substrate and forming therebetween said wave channel, said pair of transducers being capable of launching said wave in the wave channel whenever the interrogation signal is received, and converting the wave into said output response signal having a phase shift informative of the external field.

17. The device according to Claim 13, wherein said delay line is a resonator delay line characterized by a certain reference resonance frequency value, the resonator delay line being formed by a pair of reflectors placed on a surface of the piezoelectric substrate and said transducer arrangement in the

form of a single transducer between the reflectors defining the wave channel; the external electric field in the vicinity of said wave channel effecting a shift of a resonance frequency of the resonator delay line from said certain reference resonance frequency value, said shift being informative of the shift in intensity of the external electric field from a reference value.

18. The device according to Claim 13, wherein said active unit comprises a signal source, a receiver and processing means capable of determining the external field by processing the output response signal and a reference signal for further indicating the determined field.

19. The device according to Claim 13, wherein said active unit is adapted to be positioned remotely from the passive unit; both the active and passive units are provided with respective emitting-receiving antennas, and said signal source of the active unit constitutes a transmitter, thus enabling safe non-contact and remote detection of external fields and electric voltages.

20. The device according to Claim 13, and also comprising a field transformer operable to increase intensity of a field within the delay line, as compared to the intensity of the external field outside the delay line, according to a known proportion, the increased field affecting the velocity of the wave propagation within the channel.

21. A sensor for sensitive detection of external fields, the sensor being mountable at a spot where an external field is to be detected and comprising:

- a substrate made of a material capable of transporting therethrough a wave sensitive to said external field,
- a first delay line provided on said substrate to form a first wave channel for said wave's propagation contactlessly exposed to action of the external field, said first delay line comprising a first transducer arrangement capable of being actuated by a certain interrogation signal to generate said wave propagating through the first wave

channel and capable of converting the wave into a first output signal; and

- a second delay line provided on said substrate to form a second wave channel for said wave's propagation, said second delay line comprising a second transducer arrangement capable of being actuated by a certain interrogation signal to generate the wave propagating through the second wave channel and capable of converting said wave into a second output signal; wherein said second wave channel is screened from the external field and has the length differing from that of the first wave channel to ensure a phase shift between the first output signal and the second output signal;

the first and the second delay lines of said sensor are connected in parallel to provide an output response signal formed by superposition of said first and second output signals and being thereby informative of the external field.

22. The sensor according to Claim 21, wherein said first wave channel is designed to change its output signal's amplitude as the external field changes.

23. The sensor according to Claim 21, designed for detecting external magnetic fields and utilizing the substrate made of a ferrite.

24. The sensor according to Claim 21, designed for detecting external electric fields and voltages, said substrate made of a piezoelectric material.

25. The sensor according to Claim 21, designed for detecting external electric fields and voltages, said substrate made of an electrostriction material.

26. The sensor according to Claim 24, wherein said piezoelectric substrate bears:

- said first delay line comprising a first pair of transducers placed on a surface of said substrate and forming therebetween said first wave channel constituting a first acoustic channel, said transducers being capable of launching a SAW into said first channel in response to an

input electromagnetic signal and converting the SAW into a first output electromagnetic signal;

- said second delay line comprising a second pair of transducers placed on a surface of said substrate and forming therebetween said second wave channel constituting a second acoustic channel, said second pair of transducers being capable of launching SAW into said second channel in response to said input electromagnetic signal and converting the SAW into a second output electromagnetic signal;

thereby, owing to the difference in lengths of said first and said second acoustic channels, the phase of the response signal formed by superposition of said first and said second output signals is indicative of the external electric field.

27. The sensor according to Claim 26, wherein the difference in length between the two acoustic channels is equal to a quarter of the SAW wavelength in the second channel.

28. The sensor according to Claim 24, wherein said electrostriction substrate bears:

- said first delay line comprising a first pair of transducers placed on a surface of said substrate and forming therebetween said first wave channel constituting a first acoustic channel, said transducers being capable of launching a SAW into said first channel in response to an input electromagnetic signal and converting the SAW into a first output electromagnetic signal;
- said second delay line comprising a second pair of transducers placed on a surface of said substrate and forming therebetween said second wave channel constituting a second acoustic channel, said second pair of transducers being capable of launching SAW into said second channel in response to said input electromagnetic signal

and converting the SAW into a second output electromagnetic signal;

thereby, owing to the difference in lengths of said first and said second acoustic channels, the phase of the response signal formed by superposition of said first and said second output signals is indicative of the external electric field.

29. The sensor according to Claim 28, wherein the difference in length between the two acoustic channels is equal to a quarter of the SAW wavelength in the second channel.

30. The sensor according to Claim 21, wherein all said transducers are narrow band transducers.

31. The sensor according to Claim 21, wherein said first pair of the transducers is identical to said second pair of the transducers, and wherein one transducer from each pair is capable of processing a phase coded signal and the other transducer converts a signal without changing its envelope.

32. The sensor according to Claim 21, for the use as a passive unit in the device according to Claim 13.

33. A system for remotely detecting the presence of an external field at a plurality of check points to be examined, utilizing the device according to Claim 13, comprising one said active unit and a number of said passive units; said passive units of the device being mountable at the respective check points, while the active unit is capable of remotely communicating with said passive units by emitting said number of interrogation signals respectively associated with the number of the passive units and recognizing the number of respective response signals.

34. The system according to Claim 33, wherein each of said passive units comprises a pair of piezoelectric delay lines each including a phase-coded transducer, and wherein each of said interrogation signals represents a phase-coded signal matched with the phase-coded transducer's code of a

particular passive unit, thereby each of the passive units serving as a matched filter.

35. The system according to Claim 33, designed for remotely detecting the presence of high voltage between wires of an electric power line and comprising a required number of the passive units, each mountable on a particular wire of the electric power line, all said passive units being responsive to different interrogation signals, respectively, said active unit being designed in the form of a portable remote apparatus capable of selectively or simultaneously communicating with the respective passive units to allow detection and indication of the presence of high voltage regarding the particular wires bearing the respective passive units.

36. A method of contactless detection of electromagnetic fields or electric voltages utilizing the system according to Claim 33, the method comprising the steps of mounting each of said passive units at a spot where the electric field is to be detected, and activating the active unit to obtain indication of the electric field at each of said spots.

37. The method according to Claim 36, for tracing malfunctions in an electric power line, including mounting a number of said passive units at a corresponding number of check points at the electric power line, passing along the electric power line using a vehicle with the portable active unit, and remotely providing measurements of the external electric field or voltage at the number of said check points.